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MODELS AND METHODOLOGIES IN THE ANALYSIS OF REGULATION EFFECTS IN AIRLINE MARKETS

by

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ABSTRACT

In this survey, we present a detailed review of methodologies used in recent economic studies on the effects of regulation changes in airline passengers transportation. Four topics will be reviewed. Each of them involves different methodologies. The first topic concerns the effects of regulatory changes on fares and, consequently, on quality of services and route structures. The other topics are the effects of regulation on stock returns of transportation companies, the effects of regulation on productivity and costs of the companies and the identification of the beneficiaries of regulation.

Keywords : methodology, regulation, airline markets.

RÉSUMÉ

Dans cette revue, nous présentons une analyse détaillée des méthodologies utilisées récemment dans les études sur les effets de la réglementation dans le transport aérien des passagers. Quatre sujets sont abordés. Chaque sujet correspond à des méthodologies différentes. Le premier traite des effets de la réglementation sur les tarifs et, par conséquent, sur la qualité des services et les structures des routes. Les autres sujets sont les effets de la réglementation sur le rendement des actions des compagnies aériennes, les effets de la réglementation sur la productivité et les coûts des transporteurs et l'identification des bénéficiaires de la réglementation.

Mots clés : méthodologie, réglementation, marchés aériens.

INTRODUCTION

Recently, many authors have presented surveys on the economics of transportation and on the effects of regulation in the transportation industry (the last two are by Winston, 1985 and Daughety, 1985). However, they have not explained in detail the methodological approaches to the analysis of regulation effects in airline markets (passengers), even though current research has placed considerable emphasis on these aspects. Methodology is an important factor to be considered. It establishes the scientific value of research and permits the evaluation of conclusions and/or recommendations for policy purposes.

In this survey, we present a detailed review of methodologies used in recent economic studies on the effects of regulation effects in airline markets. Some issues on motor carrier freight transportation will also be discussed.

Four topics will be reviewed. Each of them involves different methodologies. The first topic concerns the effects of regulation on fares and, consequently, on quality of services and route structures. The other topics are the effects of regulation on stock returns of transportation companies, the effects of regulation on productivity and costs of the companies and the identification of the beneficiaries of regulation. We also discuss the type of data that these methodologies imply.

1. Type of data

In an important paper on methodological aspects of studies on regulation, Verleger (1972) has shown that "the results from disaggregated model indicate the inadvisability of using aggregate or cross-sectional models for the analysis of the effects of regulatory policies" (p. 437). He compared results from a cross-sectional model, an aggregate model and a point-to-point over city pairs model and showed that the parameters

estimated in aggregate or large scale cross-section models of the demand for air transportation are, at best, the average of micro parameters and possess very large variances. Moreover, "there is no reason to believe that they are unbiased averages" (p. 456).

Since this important contribution, it is now well accepted in the economic literature on transportation that disaggregated studies are the appropriate way to evaluate the effects of regulation on markets. By disaggregated studies, it is meant that data for individuals agents have to be used for either demand, supply, costs, productivity, stock returns, ... analyses. City pairs data by firm are also convenient. Moreover, the separate analysis of each product or quality (service characteristics) by firm which produces more than one product, is more appropriate than the analysis of aggregate production. For example, often, aggregate models treat air travel, usually measured in revenue passenger miles, as an homogeneous commodity. This type of commodity is not related to the microeconomic demand function for a single product. In fact, an aggregate measure of travel demand is comparable to a measure of gross output of a group of products. But, what is the market price or the quality of this product?

2. Regulation, fares, quality of services and route structures

The main issues are the following : the regulator faces a combination of possible price-service options. It is often argued that regulated fares are higher than they would be without regulation. Moreover, there are presumptions that demand quality be sensitive to flight, availability of seats and load factor and that the quality of seats offered be positively affected by regulated prices (Douglas and Miller, 1974; DeVany, 1975; Schmalensee, 1977; White 1972). Therefore, the main questions are :

1) How will deregulation on fares affect fares and quality of service?
2) How will deregulation on entry affect output in given city pairs?
3) How will deregulation affect route structures?

In order to predict these effects, different models have been proposed. Firstly, there are models which consider each firm as a member of a homogeneous industry. Demand and supply functions are estimated by using individual data, assuming that each firm has similar demand and supply conditions (Keeler, 1972; Trapani and Olson, 1981, 1982; DeVany, 1977). In these models, effects of regulatory changes depend on both demand characteristics such as willingness to pay for quality, as well as on market structure variables, such as degree of competition. Demand and market capacity equations are estimated by using cross-sectional data from individual firms. Then, predictions are made by simulations.

More particularly, Trapani and Olson (1982) presented an empirical model on the relation between fare level, open entry and the quality of services :

Market demand equation

$$q = \underset{}{\gamma_0} + \underset{(-)}{\gamma_1 p} + \underset{(+)}{\gamma_2 s} + \underset{(+)}{\gamma_3 s^2} + \underset{(-)}{\gamma_4 s^3} + \underset{(+)}{\gamma_5 y} \qquad (2.1)$$

Market capacity equation

$$s = \underset{}{\delta_0} + \underset{(-)}{\delta_1 (1/p)} + \underset{(-)}{\delta_2 k} + \underset{(+)}{\delta_3 y} + \underset{(-)}{\delta_4 h} \qquad (2.2)$$

where q is the number of passengers,

p is the fare in a given city pair,

s is the number of seats (index of service quality),

y is total disposable income in the two cities of a given city pair,

k is the weighted average cost of an available seat mile in the city pair,

h is the Herfindahl index of concentration.

The model also contains three identities for the definitions of total cost, total revenue and market profit. The parameters of the model establish the link between entry, quality (capacity) and exogenous change in price (CAB). They were estimated from a sample of 70 city pair markets in the United States and for the years 1971 and 1977 (pooling). Two stage least-squares method was used.

All coefficients estimated are significant at 95% confidence level. The estimated signs, indicated in parentheses below theoretical coefficients in (2.1) and (2.2), are those predicted by the theoretical model. For example, a reduction in concentration (h) or an increase in competition predicts an increase in the number of seats offered. However, a reduction in price (p) for a given h reduces the quality of service. These independent relations were then used to predict the price level and the load factor for a market under various values (simulation) of market concentration.

The authors found that competitive airline markets (deregulation) would lead to lower fares and lower levels of quality than those corresponding to regulated market. Moreover, very little entry is necessary in order to obtain the desired results. However, it is not clear that the competitive hypothesis is adequate for the airline markets.

Recently, many authors have presented models of airline markets behavior under the threat of entry (Keeler and Abrahams, 1981; Bailey, Graham and Kaplan, 1984; Graham, Kaplan and Sibley, 1983; and Call and Keeler, 1985). Since the last two authors have reviewed the other contributions, we shall not discuss them here. However, we shall emphasize that all these studies show evidence against the contestable markets hypothesis for the airline industry in the short run. Moreover, Call and Keeler (1985) verified "that entry of trunk carriers on the new routes has a negative and significant effect on fares" (p. 244). More studies are still

needed in order to conclude on the validity of the contestability hypothesis in the long run.

In another paper (1981), Trapani and Olson used the same data and methodology to obtain estimated parameters in order to evaluate who has benefited from regulation in the airline industry. Their results are presented in Section 5 of this survey.

In a recent study, Spiller (1983) analyzed the effects of regulation on individual firms and markets. The theory behind his approach is that regulation may affect the individual firms or markets differently (Stigler, 1971; Peltzman, 1976; Becker, 1983) and that these differences can be explained by individual firms or markets characteristics. Let us begin with his analysis concerning individual markets or city pairs. In this part of his study, the author tries to explain the differential effects on entry and price reduction across city pairs as a consequence of the 1978 partial deregulation.

The prediction is "that since the regulated fares did not take demand characteristics into account, the reduction in fares and the degree of entry across city pairs will be related to differences in demand and market characteristics. The relevant demand characteristics are the load-factor elasticity and the density of the market" (p. 678). Entry will be higher in markets where regulated price was above long-run competitive price that is when output can be expanded. "Because the degree of price reduction and output expansion depends on the willingness to pay for quality and on market density, entry should depend on those two variables" (p.77).

As in Trapani and Olson (1982), city pairs are the units of observation. However, the nature of both the data and the estimated equations are different. Spiller used as dependant variables the variation of prices between 1975 and 1980 and the number of new firms in each city pair market

during the same period. He constructed an expected load-factor elasticity index in order to approximate the impact of quality on demand using airline-by-airline demand estimates. (We shall return to these estimates later on). The index for market j is defined as

$$L_j = \sum_{i=1}^{I} b_i s_{ji}$$

where b_i is the average load-factor elasticity of the markets served by airline i

s_{ji} is the market share of firm i in city pair j

The density of the market is measured by the logarithm of total non-stop flights. The author also used the Herfindhal index for concentration. He did not have any cost information. He approximated the costs by the standard CAB coach fares.

The estimated equations were the following

$$R_j = x_j \beta_1 + \underset{(-)}{D_j \beta_1'} + \underset{(+)}{\gamma_1 L_j} + \varepsilon_j^1 \qquad (2.3)$$

$$N_j = x_j \beta_2 + \underset{(+)}{D_j \beta_2'} + \underset{(-)}{\gamma_2 L_j} + \varepsilon_j^2 \qquad (2.4)$$

where R_j is the ratio of R80 to R75,

R80 is the ratio of the lowest unrestricted fare in 1980 to the standard CAB,

R75 is the ratio of the lowest unrestricted fare in 1975 to the standard CAB fare,

x_j is a matrix of independant variables such as time, Herfindahl index volume, and dummies for regions,

D_j is the density in market j,

N_j is the number of new firms in market j since 1975.

(2.3) and (2.4) are reduced form equations. They were estimated independently and thus versions of each are presented. L_j is very significant in both equations and has the predicted sign indicated in

parentheses. Density is significant in (2.3) and is significant in one version of (2.4). This means for (2.3) that deregulation will "have an impact on unrestricted fares in markets with low-quality elasticities and in high-density ones". For (2.4), the interpretation is that "the denser a market, and the lower its quality elasticity, the larger the number of firms entering the market in the deregulation period". Moreover, the degree of concentration in 1980 is marginally positively significant in (2.3) and the degree of concentration in 1975 is not significant in (2.4). The results mean that more dense markets predicts more entry as well as larger price reductions. The larger the load-factor elasticity, the smaller the entry and the price reductions.

These results confirm those obtained in the analysis of the effects of the CAB regulatory pricing policy on individual firms which are also presented in the same article (1982).

As mentioned above, the originality of Spiller's research was to base his analysis on the characteristics of individual firms and markets. Concerning individual firms, he obtained the following important results :

1) load factor is a significant variable in the demand for airline services,
2) there are large differences across firms : some operate in markets with large valuation of quality while others do not, a result which predicts that regulatory changes should affect differently individual firms,
3) then, the author shows that firms in the low load-factor elasticity have larger fare changes and larger gain in their stock prices associated to regulatory changes.

This last result is due to the fact that these firms can benefit from price deregulation because, in the next few years, they will be able to supply low-price/low-quality services and then expand their output

significantly, activities which are not possible under price regulation. Moreover, they show that one cannot consider the industry as an homogeneous group when regulation policies are put forth or removed. Some firms benefit from regulation and others not.

Let us now present the detailed methodology of Spiller (1983) concerning the analysis of the change in regulation of fares. The methodology on stock prices variations is reviewed in Section 3 of this survey. The data are time series for individual firms(1958-1978); an observation, for one period, is an aggregate value over all routes. For each company and for each year, the author takes into account total number of flights, passengers per class, capacity per class, average trip distance, average number of stops per trip, etc,

Due to the nature of the data, the author assumes that customers of each firm have the same functional form of utility functions but differ in their random utility shocks. However, they differ across firms on the form of their utility functions. Then, using McFadden (1974) methodology, he tried to infer the preferences for quality from the choice between first-class and coach service : "In particular, ... the log of the odds of selecting first class over coach is a linear function of the quality dimension of the two services. Moreover, the elasticities of the odds with respect to each of the quality dimensions reflect the underlying preferences toward each of them." (p.662). For each airline, the following equations were then estimated as seemingly unrelated equations in order to improve the efficiency of the estimates of the parameters of equation (2.5) since part of v_t are unobservables that could affect "load factor F" :

$$\log (pr(F)/pr(\zeta))_t = b_0 + b_1 \log (\text{price } F/\text{price } \zeta)_t + \log (\text{load factor } \zeta)_t \times [b_2 + b_3 \log (\text{departures/passengers})_t] + b_4 \log (\text{distance})_t + b_5 \text{ time}_t + v_t \qquad (2.5)$$

$$\text{load factor } F = Xb_F + a_F + u_F \qquad (2.6)$$

where pr(F) is the proportion of total passengers in first class,

pr(ζ) is the proportion ot total passengers in coach class,

X is a vector of variables such as average revenue per mile in first class and coach, operating cost per flight, real income, average distance, and average number of stops,

a_F is an unobservable variable,

u_F is an error term,

$v_t = a_F + u_t$ where u_t is a well-behaved error term.

From regression results, load factor elasticities were calculated. They vary from 0.51 to 5.62. Two reasons may explain these variations : 1) differences in preference characteristics, 2) differences in economic environement and route structures. However, in the preceding analysis of city pairs, it was shown that, for given market and route structures, markets with high load-factor had smaller degrees of entry and fare reduction.

Moreover, the author estimates directly the effects of regulatory changes on airlines' average fares. Three main price policy changes were studied (1966, 1974, 1978). For each airline, the following equations were estimated :

$$YD_t = X_t'b + D_t'd + v_t$$

$$FD_t = Z_t'b_1 + D_{2t}'c_1 + u_t$$

where YD_t and FD_t are, respectively, the changes in coach fare and first-class fare

X_t and Z_t are respectively vectors of explanatory variables such as change in operating costs, real income, ...

D_t' and D_{2t}' are respectively vectors of regulatory dummy variables.

Again, the results show that firms "in markets with large load-factor elasticities show relatively small changes in their average fares when prices are regulated or deregulated. That is, the difference between the regulated and the competitive price is relatively small for those

firms" (p. 670). Even if this methodology were applied in the literature only to airlines, it is also adequate for the railroad and motor freight industry.

However, the author did not consider flight departures which were predicted to decrease with fare reduction by Douglas and Miller (1974). The predicted reduction of flight departures was recently questioned by Morrison and Winston (1985) who showed that the largest source of welfare gain from deregulation was the increase in departure frequency.

This conclusion contrasts with the above studies which predicted that the largest source of welfare gain would be associated with fare reductions that would more than compensate for reductions in service quality.

Morrison and Winston obtained the above results by using a sample of passenger trips over approximately 800 different routes. Moreover, the authors showed how, by using hub-and-spoke route structure analysis, it is possible to predict the impact of change in regulation on route structures.

They also discussed how the same methodology can also be used for motor freight transportation. However, according to the authors, more research is still needed on route structures analysis.

3. Regulation and stock return of transportation companies

Historically, many studies have used accounting data in order to evaluate group or individual company performance. However, these data are not easy to obtain for the study of regulatory changes. Stock returns are now the common sources of statistics in the analysis of whether or not regulation changes represent gains or losses to the individual firms. The Capital Asset Pricing Model (CAPM) is the more accurate tool to calculate

the variation of expected returns in asset markets due to variations of unusual events such as stock split, regulation change, etc.

The methodology consists of analysing the effects of new information (stock split or regulation change) on stock prices. (Fama et al., 1969). News of a regulatory change may cause stock prices to fluctuate. Therefore two questions are of interest : 1) Is there any unusual change in stock prices in the days or months following the announcement? 2) If the answer to the first question is positive, to what extent this change can be associated to regulatory change?

The term "unusual" (or "abnormal") means "that the actual exceeded the expected return when the expected was calculated without the information about the regulatory change" (Spiller, 1983). According to this methodology, the CAPM is used to calculate the expected return and the analysis of the residuals serves to answer the above-mentioned questions.

From the financial literature (Fama, 1976 and Copeland and Weston, 1983), the CAPM is summarized by the following equation :

$$E(R_j) = R_f + \beta_j [E(R_m) - R_f] \qquad (3.1)$$

where $E(R_j)$ is the expected return of asset j,

R_f is the expected return of the risk-free asset,

$E(R_m)$ is the expected return of the market portfolio

β_j is the beta or the systematic risk of asset j. $\beta = \frac{\sigma_{jm}}{\sigma^2_m}$ and σ^2_m is the variance of risky asset j and σ_{jm} is the covariance between asset j and the market portfolio.

(3.1) shows that the equilibrium expected return of an asset is a function of its covariance with the market portfolio. Since investors are risk averse, there should be a positive trade-off between risk and expected return. The empirical version of the model is usually written in the

following way (see Copeland and Weston, pp. 205-206, for more details) :

$$R_{jt} = R_{ft} + \beta_j [R_{mt} - R_{ft}] + \varepsilon_{jt} \qquad (3.2)$$

where R_{mt} is the return on the market portfolio in period t,

R_{jt} is the return on asset j in period t,

R_{ft} is the return on the risk free asset in period t,

ε_{jt} is an error term with zero mean and variance equal to $\sigma^2_{\varepsilon j}$

If R_f is constant over time (3.2) can be reduced to

$$R_{jt} = (1-\beta_j) R_{ft} + \beta_j R_{mt} + \varepsilon_{jt} \qquad (3.3)$$

Spiller (1983) estimated the returns of each airline in order to analyze the regulatory changes of 1966 and 1974 in the United States. For each regulatory change, he used a time period of sixty months before the announcement. Then, assuming that all the abnormality is a result of the regulatory changes, he used the residuals, divided by the sample standard deviation of the residuals, in order to measure the change in return due to change in regulation.

He found no significant results for 1974 but obtained some significant results for 1966. He attributed the negative results for 1974 to the fact that the regulatory change was anticipated by the stock market since the deregulation process was a long one. However, in two other papers (Spiller, 1982, 1984), the author questioned the above methodology.

The point is that "since regulatory changes seem to affect not only the profitability but also the systematic risk of the regulated asset, simple "residual" analysis may not uncover the true impact of regulatory changes. If, for instance, a regulatory decision increases both the profitability and the systematic risk of the firm, since both changes have opposite effects on stock prices, the overall effect as revealed in the stock prices may be relatively small" (Spiller, 1982, pp. 369-370). Therefore, profitability change has to be separated from risk change. In order to

isolate the profitability change associated with regulatory change, we must subtract from the residuals the part that is risk-related.

In his 1982 paper, the author presented a methodology which separates both changes in the analysis of the residuals. The details are not presented here. In a following paper (1984), he implemented the methodology and presented empirical results showing the usefulness of the methodology. The improvement concerns the type of information used.

Since deregulation is a long and slow process, the impact of several events such as reports, announcements, and voting, have to be taken into account and the total of the cumulative residuals associated with these events is the appropriate measure of the overall effect of the regulatory change. For example, the author used five events from 1974 to 1978 (Brookings Report (1974); President asks to deregulate (1977); President sends regulation bill (1977); Bill cleared by the sub-committee (1978); Bill approved by the Congress (1978)) in analyzing the airline deregulation. Spiller found significant profitatility effects for many companies and non uniform changes across firms, a result consistent with those on fares and entry levels presented in the preceding section of the survey.

In this way, he showed a statistical relationship between change in stock prices and deregulation assuming that all abnormality comes from the regulatory change. Therefore, the methodology is still not perfectly adequate to answer the second above-mentioned question, since other possible events are not isolated. Only a multivariate analysis of the residuals can isolate the regulatory change effect from other effects (if any).

4. Regulation, costs and productivity

It is well recognized in the economic literature that regulation procures benefits for certain groups or individual agents. Usually, three major groups can be identified as beneficiaries of regulation : the owners

of stocks, the owners of production factors and the consumers. In the transportation literature, mainly the airline industry and the motor freight industry, most of the authors agree on the fact that regulation confers benefits to the owners of factors[1]. For example, Trapani and Olson (1981) have shown that regulation of the airline industry in the U.S. benefited aircraft manufacturers, fuel suppliers and other inputs suppliers. In the motor carrier industry, Moore (1978) for the U.S. and, later, Kim (1984) for Canada, have shown that regulation in this industry has benefited labour suppliers. In both cases, benefits take the form of over-utilization of inputs in producing a given level of output.

Since regulation seems to imply a sub-optimal utilization of resources, productivity should be lower under regulation than it would have been in the absence of it. Hence, in comparing productivity trends in an industry which experienced regulatory changes or in comparing productivity trends of different segments of an industry facing different regulatory environments, we should be able to determine the effects of regulation on the productivity of transportation firms.

4.1 The measures of productivity

Intuitively, productivity is mainly a ratio of outputs over inputs. More productivity means that it is possible to produce a given level of outputs with less inputs or that an increase in inputs leads to a more than proportional increase of outputs.

In the airline and motor freight industries, outputs and inputs are multiple. For example, in the airline industry, inputs take the form of fuel, equipment, labour. Outputs take the form of first class and coach class passengers services, freight, mail, charter flights, etc. Hence, in order to measure precisely global productivity levels or growth, it is necessary to use an index of productivity rather than a simple ratio of outputs over inputs.

One of the approaches used in evaluating productivity with multiple inputs and outputs is the total factor productivity indexes (TFP) approach. Total factor productivity indexes compares the aggregate output level to the aggregate input level. TFP indexes is the ratio of two separate indexes, one for outputs and one for inputs. The Divisia index is a methodology used in estimating TFP levels and then, the TFP rates of growth. The rate of growth is given by :

$$\underset{(\Delta TFP)}{\ln (TFP_t) - \ln (TFP_{t-1})} = \sum_i \frac{(r_{i,t} + r_{i,t-1})}{2} \ln \left(\frac{Q_{i,t}}{Q_{i,t-1}}\right) - \sum_j \frac{(s_{j,t} + s_{j,t-1})}{2} \ln \left(\frac{X_{j,t}}{X_{j,t-1}}\right) ; \tag{4.1}$$

where $r_{i,t}$ is revenue share of output Q_i in total revenues of period t,

$s_{j,t}$ is cost share of input X_j in total costs of period t.

This method was first introduced by Christensen and Jorgensen (1970) and was used by Cofsky and Roy (1984) to evaluate the TFP rates of growth of six Canadian airlines.

An extension to the Divisia index methodology is the translog multilateral TFP comparison index methodology. With this method, instead of measuring TFP in absolute terms, TFP is measured with respect to the productivity of all firms in the industry. In establishing their translog multilateral index method, Caves, Christensen and Diewert (1982) first defined a translog multilateral output comparison index as follows :

$$\underset{(\Delta Q_k)}{\ln (Q_{k,t}) - \ln (Q_{k,t-1})} = \sum_i \frac{(r_{i,k,t} + \bar{r}_{i,t})}{2} \ln \left(\frac{Q_{i,k,t}}{\tilde{Q}_{i,t}}\right) - \sum_j \frac{(r_{i,k,t-1} + \bar{r}_{i,t-1})}{2} \ln \left(\frac{Q_{i,k,t-1}}{\tilde{Q}_{i,t-1}}\right) ; \tag{4.2}$$

where $Q_{i,k,t}$ is output of type i for airline k in period t,v

$r_{i,k,t}$ is revenue share of output i for airline k in period t,

$\bar{}$ is for the arithmetic mean and $\tilde{}$ for the geometric mean.

Then, the authors defined the translog multilateral input comparison index as :

$$\underset{(\Delta X_k)}{\ell n(X_{k,t}) - \ell n(X_{k,t-1})} = \sum_j \frac{(s_{j,k,t} + \bar{s}_{j,t})}{2} \ell n \left(\frac{X_{j,k,t}}{\tilde{X}_{j,t}}\right) - \sum_j \frac{(s_{j,k,t-1} + \bar{s}_{j,t-1})}{2} \ell n \left(\frac{X_{j,k,t-1}}{\tilde{X}_{j,t-1}}\right) ; \quad (4.3)$$

where $X_{j,k,t}$ is input of type j for airline k in period t,

$s_{j,k,t}$ is cost share of input j for airline k in period t.

Using the above definitions (4.2, 4.3) the translog multilateral TPF comparison index can be written as :

$$\underset{(\Delta TFP_k)}{\ell n(TFP_{k,t}) - \ell n(TFP_{k,t-1})} = (\ell n(Q_{k,t}) - \ell n(Q_{k,t-1})) - (\ell n(X_{k,t}) - \ell n(X_{k,t-1})) \quad (4.4)$$

4.2 Sources of growth

Once total productivity levels and rates of growth have been measured, one needs to identify the factors that are responsible for the growth. There are two types of TFP growth which can be identified : firstly, growth due to changes in specific quantifiable operating characteristics (output level, average stage length and available capacity) and, second, residual or unexplained TFP growth due to changes in regulation, managerial efficiency and other factors. In order to separate TFP growth into its main components, Caves, Christensen and Tretheway (1983) proposed a covariance model in which TFP growth is the dependent variable. Covariates can be introduced for operating characteristics, and binary variables can be introduced to capture average annual TFP growth which is not explained by the covariates.

Formally, their empirical model is the following :

$$\ell n(TFP_{k,t})-\ell n(TFP_{k,t-1})=\beta_1(\ell n(OP_{k,t})-\ell n(OP_{k,t-1}))+\beta_2(\ell n(ASL_{k,t})-\ell n(ASL_{k,t-1}))$$

$$+\beta_3(\ell n(LF_{k,t})-\ell n(LF_{k,t-1}))+\beta_4(\ell n(CAP_{k,t})-\ell n(CAP_{k,t-1}))+\sum_{t=1971}^{1980}\delta_t D_t+\ell_{k,t}$$

where OP is output, ASL is average stage length, LF is load factor and CP is available capacity (for airline k).

D_t are binary variables having the values unity in year t and zero in other years (unknown components).

$\ell_{k,t}$ is the usual error term.

When the model is estimated, it is easy to separate TFP growth into its known and unknown components and then, to compare the unknown components with regulatory changes that may have occurred.

The results obtained by Caves, Christensen and Tretheway (1983) show that in the first five years of transition to deregulation (1975-1979), the U.S. airline industry achieved very rapid growth of TFP. They also show that this growth was due for a large part to the unexplained component of TFP growth (around 33% to 50% of total growth). However, in 1980, the TFP growth decreased rapidly. In that year, the unexplained component of TFP growth was approached zero.

In the Canadian context, Cofsky and Roy (1984) and Gillen, Oum and Tretheway (1985) used the same methodology in investigating TFP growth of airlines. But, since the airline industry in Canada has not yet experienced large scale deregulation, it was difficult to estimate the effects of regulation on productivity or TFP growth.

The methodology itself is not free of criticism. Indeed, in the analysis of covariance for the identification of growth sources, all the unexplained components of TFP growth rate for a given year, are implicitly imputed to regulatory changes. In fact, nothing in this method allows for

the decomposition of the unknown component into its different parts (regulation, managerial efficiency, etc.). The addition of specific binary variables for regulation to the yearly binary variables could be helpful for the decomposition of the unknown component and the identification of regulatory impact on TFP.

Recently, Caves, Christensen and Tretheway (1984) have extended this line of research and have estimated costs functions. They have found substantial economies of density and constant returns to scale for air carriers, using a panel data set for the years 1970 through 1981 of all trunk and local service airlines. Similar results were obtained for Canadian airlines by Gillen, Oum and Tretheway (1985). However, these studies did not analyze explicitly the effect of deregulation on costs. In another study on costs, Koford and Gillotti (1985) have verified that deregulation variables have no effect on short run costs. This result is consistent with the above result that the unexplained component of TFP growth was approaching zero in 1980 (Caves, Christensen and Tretheway, 1983).

5. The beneficiaries of regulation

Government regulation of many industries is mainly established to protect the interests of consumers. However, as mentioned above, many authors (Stigler, 1971 and Peltzman, 1976) argued that regulation is often undertaken in response to demand by special interests groups and that it serves the interests of the most powerful groups. Therefore, in a particular situation, if the government decides to regulate an economic activity where the consumers cannot exercise a certain power, the effects of regulation may not benefit them. In this case, regulation will not achieve its goal.

At a relatively aggregate level, three major groups can be identified as beneficiaries of regulation : the owners of factors of production,

the owners of stocks and the consumers. This section will review two different methodologies used in the identification of beneficiaries of regulation, one used in the airline industry and the other in the trucking industry.

5.1 The beneficiaries of airline regulation

The theoretical and empirical models used by Trapani and Olson (1981, 1982) and presented in Section 2 are very useful for investigating the question of the beneficiaries of regulation. First introduced by Douglas and Miller (1974) and DeVany (1977), the theoretical background used by Trapani and Olson establishes criteria from which one can identify the beneficiaries of regulation in the airline industry.

Two criteria permit the identification of the beneficiaries. Firstly, if the regulatory agency sets the fares in order to maximize the profit[2] of the individual airline firms, one should observe (empirically) the following relationship in a city pair market :

$$-\beta_1 = \beta_2 \frac{p \cdot q}{k \cdot s} \qquad (5.1)$$

where β_1 is the elasticity of demand with respect to fare,

β_2 is the elasticity of demand with respect to the number of seats available (a measure of level of service),

p is the airline service fare,

q is the demand for airline service,

k is the cost per seat,

s is the number of seats available.

Pricing policy of the regulatory agency is said to be profitable to the stockholders if relation (5.1) is observed in the airline industry. Relation (5.1) can be observed in a monopoly market or in a market where the regulatory agency will guarantee closed entry and act as a cartel manager in order to avoid scheduling rivalry. Hence, with closed entry and

no scheduling rivalry, the firms in the market will adjust the number of seats available according to the fare set by the regulatory agency in order to maximize profits.

A second relation can be observed in a city pair market. It implies that output is maximized :

$$-\beta_1 = \beta_2 \cdot \alpha_1 \qquad (5.2)$$

where α_1 is the price elasticity of seats available.[3]

If fare set by the regulatory agency is such that relation (5.2) holds, the number of passengers in a city pair market will be maximized. Relation (5.2) is based upon the argument that the quality of service (here measured by the number of seats available) is entered into the airline market model. In fact, more seats would imply less delay costs associated with a flight and, thus, an increase in the demand for airline service (assuming that airline service demand is not only a function of the fare but also a function of the quality of service). Since the regulatory agency, by its pricing policy, determines the number of seats available in a city pair market, it also determines the full cost (fare + delay costs) of a passenger flight. Hence, the pricing policy of the regulatory agency can benefit consumers if fares are established in order to minimize the full cost of a passenger flight and therefore maximize the number of passengers in the city pair markets.

Another situation can prevail in a city pair market where neither relation (5.1) nor relation (5.2) are observed. This is a situation where the pricing policy of the regulatory agency is such that the fares are so high that the firms must enter into a scheduling rivalry in order to attract consumers. In this situation, fares levels are well above both the profit maximization level and the output maximization level which leads to an over-utilization of inputs such as the crew and fuel. In observing the above situation, one may conclude that the beneficiairies of regulation are

mainly the owners of factors of production.

For the U.S., Trapani and Olson (1981) found that the Civil Aeronautics Board (CAB) pricing policy benefited the owners of factors of production in 1971. Fares were set at a level which forced the firms to enter into a scheduling rivalry and thus lead to an over-utilization of resources. However, after 1971 and up to 1977, CAB pricing policy was modified and a profit maximization solution was observed. Thus distribution of benefits changed in favor of stock holders. However, as shown by Spiller, these benefits varied across companies.

5.2 The beneficiaries of trucking regulation

Many studies of the trucking industry concluded that the regulatory regime in the Canadian trucking industry leads to fares higher than those corresponding to the absence of regulation (see for example Sloss (1970), Maister (1978) and McLachlan (1972)). However, it seems that higher fares do not necessarily mean higher profits. Rather, it is possible that regulation induces over-utilization of factors of production and then higher fares.

In investigating this hypothesis, Moore (1978) found that "three-quarter or more of the cost to shippers and ultimately to consumers of trucking regulation take the form of income transfer to labour and capital involved in trucking" (Moore, 1978, p. 342).

Assuming that the Canadian trucking regulatory regime, in imposing route structure (network), fare, etc., leads to a sub-optimal production structure, Kim (1984) introduced "conditions induced by the regulatory regime that directly affect the production technology and consequently the cost of producing regulated trucking services" (p. 228). Regulation can affect the production structure (or technology) of the trucking firms in many ways. Empty backhauls, excess circuitry, under-utilization of capacity

(because of the restrictions on the type of commodities that may be hauled) are some of the consequences of a regulatory regime. In order to take into account the effects of a regulatory regime on the production structure of the carriers, Kim used what he called a vector of regulatory-induced technological conditions. These regulatory-induced conditions are the average length of haul (H), the average shipment size (S), and the level of capacity utilization (CU).[4] All three variables are proxies for taking into account the effects of regulation on the production structure of the carriers. The author assumed that in the presence of regulation, H, S and CU are lower than they would be otherwise.

To evaluate the effects of the regulatory-induced conditions on the production structure of the carriers, Kim has estimated a translog cost function[5] and four factor-demand functions (labour, fuel, capital and materials). The variables of the cost function are the prices of inputs, the level of output, a series of regional dummy variables and the three regulatory-induced condition variables. Kim used Canadian data compiled by Statistics Canada from the 1975 Motor Carrier's Freight Survey (MCF) and the 1975 For-Hire Trucking Origin and Destination Survey (TOD). In his study, Kim used data on ninety-nine firms from the provinces of Quebec, Ontario, Manitoba, Alberta and British-Columbia.

Once the cost functions had been estimated, Kim found that the three regulatory-induced conditions had a negative effect on the cost. Moreover, it seems that the main effect comes from the capacity utilization variable (CU). Hence, Kim supposes that, in absence of regulation, capacity utilization would be higher and thus costs lower.

The more interesting result comes from the estimation of the factor demand equations. According to the results obtained by Kim, it seems that the regulatory-induced conditions exert in average, a negative impact on factors demand. Absence of regulation in this context would mean a lower utilization of mainly labour and fuel. Therefore, it is very likely that

the main beneficiaries of the Canadian trucking regulation are the input suppliers, mainly labour and fuel, because of the sub-optimal production structure induced by regulation. Also, there is a possibility of scheduling rivalry (because of fare regulation) leading to an excess capacity in the industry and thus benefiting inputs.

The methodology used by Kim has at least two weaknesses. Firstly, Kim assumed that regulation exerts a negative impact on the average length of haul, the average shipment size, and on the level of capacity utilization without demonstrating it empirically. In order to evaluate the exact effect of regulation on costs and factor demands, it would be preferable to first estimate the impact of regulation or H, S and CU. Then, in a second step, the evaluation of the impact of H, S and CU on costs and factor demands will provide the empirical evidence of the effects of regulation.

The second weakness of Kim's study is that all the provinces were assumed to face the same regulatory policy. This constitutes a very strong hypothesis since we know that, for example, Alberta does not face any type of regulation in intraprovincial trucking. Different estimations by province (or by group of provinces facing identical regulatory policy) would avoid such a problem.

Finally, as mentioned in the preceding sections, Spiller has shown that the benefits from regulation vary across agents in a given group and, more particularly, across airlines. It would be interesting to get data permitting to verify whether this result also applies to input suppliers in the trucking industry.

CONCLUDING COMMENT

The object of this survey was to present a review of methodologies used in recent economic studies on the effects of regulation in airline markets. The articles reviewed were choosen for their originality and their differences from other research paths known in the literature (Winston (1985) and Daughety (1985)). Moreover, many of these models were built up in order to take into account (with few exceptions) the characteristics of airline markets. One interesting avenue of research would be to extend them to other markets.

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NOTES

[1] See Section 5 for more details about the beneficiaries of regulation.

[2] For more details about the effect of price setting on the operation of the airline firms, see Section 2.

[3] Price elasticity of seats available measures the response of the firms in terms of seats offered when fares are changing.

[4] Average length of haul : ratio of total miles driven by the carrier to total number of shipments (measured in miles).
Average shipment size : ratio of total tons hauled during the year to total amount of shipments.

Capacity utilization : ton-miles per truck.

[5] For surveys on costs functions in the trucking industry, see Winston (1985) and Daughety (1985).

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